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Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labelling of Chemicals

Sub-Committee of Experts on the Transport of Dangerous Goods

Forty-fifth session
Geneva, 23 June – 2 July 2014
Item 5 (e) of the provisional agenda
Electric storage systems: miscellaneous

Transport of lithium batteries of small productions runs or prototype lithium batteries in equipment

Transmitted by the expert from Germany[1]

Introduction

1. Special provision 310 excludes batteries from production runs consisting of not more than 100 cells or batteries and prototypes when these are transported for testing from the application of the testing requirements in sub-section 38.3 of the Manual of Tests and Criteria.

2. This special provision is assigned to UN 3090 and UN 3480 but not to UN 3091 and UN 3481. As a consequence, equipment containing such batteries cannot be transported legally.

3. In practice, this causes difficulties, for instance in the manufacturing of highly specialized devices that are produced in small quantities only and into which batteries are installed that have been specially developed for such devices. In Germany, for example, there was a request regarding the transport of a submarine for military purposes (no vehicle, as not suitable for the transport of people or goods). Only a few of these submarines are produced. The question of transport, however, also arises in the case of other types of devices of small production runs or of custom-builds with specifically designed lithium

[1] In accordance with the programme of work of the Sub-Committee for 2013-2014 approved by the Committee at its sixth session (refer to ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

batteries such as individually manufactured robots. It is not always possible to remove the batteries for transport, and removing them does not automatically improve safety.

4. Prototypes, too, might need to be transported in equipment for test purposes, e.g. in the case that the battery is to be tested installed in a component or the complete device is to be tested as a prototype with the battery installed.

5. It should also be made possible to transport lithium batteries in devices in accordance with special provision 310. Here, it should also be considered that very large devices do not fit into a suitable packaging; in these cases, the transport can be effected under the conditions laid down by the competent authority.

6. This opportunity should also be used to clarify that batteries which have been damaged within the framework of testing have to be transported under the conditions for damaged batteries.

Proposal

7 For UN 3091 and UN 3481: Assign "301" in column 6 of the dangerous goods list.

8 Amend special provision 310 as follows:

301 The testing requirements in Chapter 38.3 of the Manual of Tests and Criteria do not apply to production runs consisting of not more than 100 cells and batteries, or to pre-production prototypes of cells and batteries when these prototypes are transported for testing, if the following conditions are met:

(a) Cells and batteries:

(ia) The cells and batteries are transported in an outer packaging that is a metal, plastics or plywood drum or a metal, plastics or wooden box and that meets the criteria for packing group I packagings; and

(bii) Each cell and battery is individually packed in an inner packaging inside an outer packaging and is surrounded by cushioning material that is non-combustible, and non-conductive.

(b) Cells and batteries contained in equipment:

(i) The cells and batteries contained in equipment are transported in an outer packaging that is a metal, plastics or plywood drum or a metal, plastics or wooden box and that meets the criteria for packing group I packagings; and

(ii) The cells and batteries are protected against short circuit.

Large equipment may be transported unpackaged under conditions specified by the competent authority.

(c) Identified damaged or defective cells and batteries shall be transported in accordance with special provision 376 and packaged in accordance with P908 of 4.1.4.1 or LP904 of 4.1.4.3, as applicable.

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Sub-Committee of Experts on the Transport of Dangerous Goods

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Geneva, 23 June – 2 July 2014
Item 4 (c) of the provisional agenda
Listing, classification and packing: miscellaneous

Editorial amendment to P 906

Transmitted by the expert from Germany[1]

Introduction

1. An amendment to the proper shipping name of Nos. 3151 and 3152 was adopted on the basis of document ST/SG/AC.10/C.3/2013/55 (Germany) during the last session of the Sub-Committee. The scope of those two shipping names was extended to cover halogenated monomethyldiphenylmethanes which have similar chemical and ecotoxicological properties to polychlorinated biphenyls (PCBs) and polychlorinated terphenyls (PCTs).

2. This amendment requires a consequential editorial amendment to P 906 which was overlooked.

[1] In accordance with the programme of work of the Sub-Committee for 2013-2014 approved by the Committee at its sixth session (refer to ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

Proposal

3. Amend P 906 as follows:

P 906	PACKING INSTRUCTION	P 906
This instruction applies to UN Nos. 2315, 3151, 3152 and 3432.		
The following packagings are authorized, provided that the general provisions of **4.1.1** and **4.1.3** are met: (1) For liquids and solids containing or contaminated with PCBs or polyhalogenated biphenyls or terphenyls or halogenated monomethyldiphenylmethanes: Packagings in accordance with P001 or P002, as appropriate. (2) For transformers and condensers and other devices: (a) Packagings in accordance with packing instructions P001 or P002. The articles shall be secured with suitable cushioning material to prevent inadvertent movement during normal conditions of transport; or (b) Leakproof packagings which are capable of containing, in addition to the devices, at least 1.25 times the volume of the liquid PCBs, polyhalogenated biphenyls, ~~or~~ polyhalogenated terphenyls or halogenated monomethyldiphenylmethanes present in them. There shall be sufficient absorbent material in the packagings to absorb at least 1.1 times the volume of liquid which is contained in the devices. In general, transformers and condensers shall be carried in leakproof metal packagings which are capable of holding, in addition to the transformers and condensers, at least 1.25 times the volume of the liquid present in them. Notwithstanding the above, liquids and solids not packaged in accordance with P001 and P002 and unpackaged transformers and condensers may be transported in cargo transport units fitted with a leakproof metal tray to a height of at least 800 mm, containing sufficient inert absorbent material to absorb at least 1.1 times the volume of any free liquid.		
Additional requirement: Adequate provisions shall be taken to seal the transformers and condensers to prevent leakage during normal conditions of transport.		

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Item 6 (b) of the provisional agenda
Transport of gases: miscellaneous

Packing instructions P200 and P206 for collective entries

Transmitted by the expert from Germany[1]

Introduction

1. At its forty-forth session, the Sub-Committee considered a proposal to amend packing instructions P200 and P206 and to include instructions how to calculate the filling ratio and test pressure when a liquid phase of a fluid is charged with a compressed gas (see ST/SG/AG.10/C.3/2013/41). Some experts considered that this would be better addressed through standards and that it was not desirable to include such detailed calculation formulae in regulations which should contain the essential requirements. Others supported the proposal in general and provided some editorial remarks.

2. The expert of Germany is still of the opinion that an amendment of P 200 and P 206 is necessary. There are no appropriate standards to be referenced in the provisions, therefore the instructions have to be included in the Model Regulations.

3. For the collective entries

- UN 1058 "LIQUEFIED GASES, non-flammable, charged with nitrogen, carbon dioxide or air"
- UN 3157, 3160, 3161, 3162, 3163, 3307, 3308, 3309, 3310 "LIQUEFIED GAS, XXXX, N.O.S.",

[1] In accordance with the programme of work of the Sub-Committee for 2013–2014 approved by the Committee at its sixth session (see ST/SG/AC.10/C.3/84, para. 86 and ST/SG/AC.10/40, para. 14).

- UN 3500, 3501, 3502, 3503, 3504, 3505 "CHEMICAL UNDER PRESSURE, XXXX, N.O.S."

P200 (3) or P206 (3), respectively, is applicable for the calculation of the filling ratio and the test pressure.

4. For cases where a liquid phase of a fluid is charged with a compressed gas, the above packing instructions do not include instructions on how to calculate the filling ratio and test pressure. In these cases, both components – the liquid phase and the compressed gas – have to be taken into consideration in the calculation of the internal pressure in the pressure receptacle.

This is shown in Figure 1:

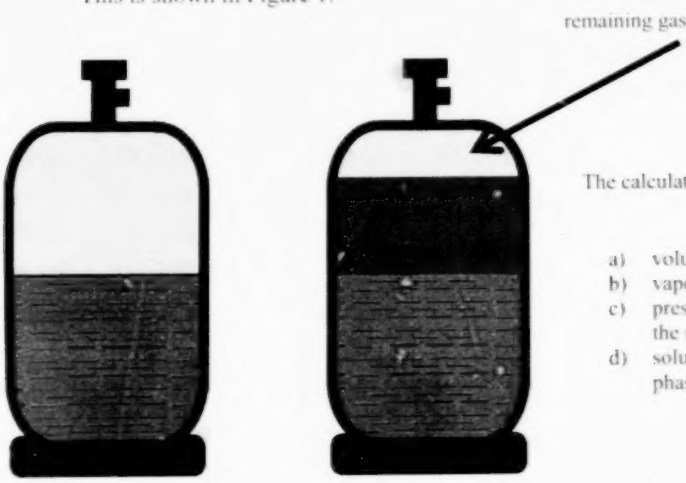
remaining gas volume
The calculation has to consider the following:
a) volumetric expansion of the liquid phase;
b) vapour pressure at 65 °C;
c) pressure of the compressed gas at 65 °C in the reduced volume;
d) solubility of the compressed gas in the liquid phase.
T = 15 °C
T = 65 °C

Fig. 1: Schematic presentation of the volumetric expansion for the calculation of the internal pressure in pressure receptacles containing liquid phases and compressed gas

5. If only the compressed gas is considered in accordance with P200 (3) (a), this results in calculated pressures which are too low and not acceptable from the point of view of safety. If only the vapour pressure of the liquefied component at 65 °C is considered in accordance with P200 (3) (c) and/or P206 (3), this also result in calculated pressures which are too low and not acceptable from the point of view of safety.

6. A complete calculation formula is not given in P200 and P206. Experimental values are often also not available. A calculation on the basis of the existing provisions may lead test pressures that are too low, this is illustrated by the following example:

Example

Gas for use in hot air balloon:

UN 1978 propane, charged with 5 bar(abs) nitrogen

According to existing P 200:

Filling ratio (P200 (c)) = (0.0032 x BP – 0.24) x dl = (0.0032 x 231 – 0.24)x 0.5809 = **0,29 kg/l**

Test pressure (P200 (c)) = vapour pressure at 65 °C – 1 bar = (23.43 – 1) bar = **22.4 bar**

According to proposed amendment P200 (see para6):

(a) Vapour pressure and partial pressure at filling temperature /1/vapour pressure propane (15 °C) = 7.315 bar(abs)partial pressure nitrogen (15 °C) = 5 bar(abs)

(b) Volumetric expansion of liquid phase from 15 °C to 65 °C /1/filling ratio = 0,29 kg/l, liquid density (15 °C) = 0.5075 kg/l, liquid density (65 °C) = 0.4163 kg/lvolumetric expansion of liquid phase: From 0.571 l (15 °C) to 0.6966 l (65 °C), remaining gas volume in the gas cylinder: 1-0.571 = 0.429 (15 °C), 1-0.6966 (65 °C) = 0.303 (65 °C)

(c) Partial pressure of nitrogen at 65 °CpN2 = 5 x 338.15/288.15 x 0.429/0.303 = 8.3 bar(abs)

(d) Vapour pressure at 65 °C /1/pv (65 °C) = 23,43 bar(abs)

(e) Total pressure at 65 °Cpt (65 °C) = 23,43 bar + 8,3 bar = 31.73 bar(abs)

7. A similar approach to calculating test pressures (design pressure) taking into account both the compressed gas and the liquid phase for tanks is given under 6.7.2.1 and 6.7.3.1.

Proposal

8. The following amendments to P200 and P206 are proposed (amended text compared to document 2013/41 is printed underlined)

Insert a new paragraph (e) in P200 (3):

"(e) For liquefied gases charged with compressed gases, both components – the liquid phase and the compressed gas – have to be taken into consideration in the calculation of the internal pressure in the pressure receptacle.

The maximum mass of contents per litre of water capacity shall equal 0.95 times the density of the liquid phase at 50 °C; in addition, the liquid phase shall not completely fill the pressure receptacle at any temperature up to 60 °C.

When filled, the internal pressure at 65 °C shall not exceed the test pressure of the pressure receptacles. The vapour pressures and volumetric expansions of all substances in the pressure receptacles shall be considered. When experimental data is not available, the following steps shall be carried out:

(a) Calculation of the vapour pressure of the liquid component and of the partial pressure of the compressed gas at 15 °C (filling temperature);

(b) Calculation of the volumetric expansion of the liquid phase resulting from the heating from 15 °C to 65 °C and calculation of the remaining volume for the gaseous phase;

(c) Calculation of the partial pressure of the compressed gas at 65 °C considering the volumetric expansion of the liquid phase;

(d) Calculation of the vapour pressure of the liquid component at 65 °C;

(e) The total pressure is the sum of the vapour pressure of the liquid component and the partial pressure of the compressed gas at 65 °C;

(f) Consideration of the solubility of the compressed gas at 65 °C in the liquid phase;

The test pressure of the pressure receptacle shall not be less than the calculated total pressure minus 100 kPa (1bar).

If the solubility of the compressed gas in the liquid component is not known for the calculation, the test pressure can be calculated without taking the gas solubility (paragraph (f)) into account.

At the end of P206 (3), add the following paragraph:

For liquids charged with a compressed gas both components – the liquid phase and the compressed gas – have to be taken into consideration in the calculation of the internal pressure in the pressure receptacle. When experimental data is not available, the following steps shall be carried out:

(a) Calculation of the vapour pressure of the liquid component and of the partial pressure of the compressed gas at 15 °C (filling temperature);

(b) Calculation of the volumetric expansion of the liquid phase resulting from the heating from 15 °C to 65 °C and calculation of the remaining volume for the gaseous phase;

(c) Calculation of the partial pressure of the compressed gas at 65 °C considering the volumetric expansion of the liquid phase;

(d) Calculation of the vapour pressure of the liquid component at 65 °C;

(e) The total pressure is the sum of the vapour pressure of the liquid component and the partial pressure of the compressed gas at 65 °C;

(f) Consideration of the solubility of the compressed gas at 65 °C in the liquid phase.

The test pressure of the cylinders or pressure drums shall not be less than the calculated total pressure minus 100 kPa (1bar).

If the solubility of the compressed gas in the liquid component is not known for the calculation, the test pressure can be calculated without taking the gas solubility (paragraph (f)) into account.